

PCT

NOTIFICATION OF THE RECORDING
OF A CHANGE

(PCT Rule 92bis.1 and
Administrative Instructions, Section 422)

From the INTERNATIONAL BUREAU

To:

BARNARD, Eric, Edward
Brookes Batchellor
102-108 Clerkenwell Road
London EC1M 5SA
ROYAUME-UNI

RECEIVED
JUL 27 2001
TC 3700 MAIL ROOM

Date of mailing (day/month/year) 09 July 2001 (09.07.01)	IMPORTANT NOTIFICATION
Applicant's or agent's file reference EEB/GCF	
International application No. PCT/GB00/02266	International filing date (day/month/year) 12 June 2000 (12.06.00)

1. The following indications appeared on record concerning:

☐ the applicant ☐ the inventor ☒ the agent ☐ the common representative

Name and Address BARNARD, Eric, Edward Brookes & Martin High Holborn House 52/54 High Holborn London WC1V 6SE United Kingdom	State of Nationality	State of Residence
	Telephone No. 020 7242 9631	
	Facsimile No. 020 7831 0586	
	Teleprinter No.	

2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:

☐ the person ☒ the name ☒ the address ☐ the nationality ☐ the residence

Name and Address BARNARD, Eric, Edward Brookes Batchellor 102-108 Clerkenwell Road London EC1M 5SA United Kingdom	State of Nationality	State of Residence
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3. Further observations, if necessary:

4. A copy of this notification has been sent to:

☒ the receiving Office ☒ the designated Offices concerned
☐ the International Searching Authority ☐ the elected Offices concerned
☐ the International Preliminary Examining Authority ☐ other:

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No.: (41-22) 740.14.35	Authorized officer HA Ki-Nam Telephone No.: (41-22) 338.83.38
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(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
21 December 2000 (21.12.2000)

PCT

(10) International Publication Number
WO 00/76722 A2

- (51) International Patent Classification: B24B 31/00 (74) Agent: BARNARD, Eric, Edward; Brookes & Martin, High Holborn House, 52/54 High Holborn, London WC1V 6SE (GB).
- (21) International Application Number: PCT/GB00/02266
- (22) International Filing Date: 12 June 2000 (12.06.2000) (81) Designated States (national): AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data: 9913658.2 11 June 1999 (11.06.1999) GB
- (71) Applicant (for all designated States except US): NSK-RHP EUROPEAN TECHNOLOGY CO. LIMITED (GB/GB): Mere Way, Ruddington Fields Business Park, Ruddington, Nottinghamshire NG11 6JZ (GB).
- (84) Designated States (regional): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).
- (72) Inventors; and
- (75) Inventors/Applicants (for US only): DODD, Andrew (GB/GB): 6 Halls Brook, East Leake, Loughborough, Leicestershire LE12 6HE (GB). DICKS, Mark, Philip (GB/GB): 20 Hine Avenue, Newark, Nottinghamshire NG24 2LH (GB). TAYLOR, Mark, Stephen (GB/GB): 10 Bateman Road, East Leake, Loughborough, Leicestershire LE12 6LN (GB).
- Published:
— Without international search report and to be republished upon receipt of that report.
- For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: IMPROVEMENTS IN ROLLING ELEMENTS BEARINGS

(57) Abstract: A method of treatment of a rolling element bearing component by hard particle abrasion to improve the surface topography of the component. The hard particle abrasion includes the steps of immersing the bearing component in a receptacle containing hard particles, preferably alumina, and agitating the component and/or hard particles to produce relative movement. Preferably the method is performed for between 10 minutes and 1 hour. The relative movement may be produced by rotating the component in one direction while the receptacle is rotated in the opposite direction. The surface finish of the component is preferably improved from around 0.13 μm to around 0.07 μm . Compressive stress in the surface of the component may also be improved, typically by between 200 MPa and 500 MPa. Rolling contact fatigue life of the component is also improved.

PATENT COOPERATION TREATY

PCT

NOTICE INFORMING THE APPLICANT OF THE
COMMUNICATION OF THE INTERNATIONAL
APPLICATION TO THE DESIGNATED OFFICES

(PCT Rule 47.1(c), first sentence)

From the INTERNATIONAL BUREAU

To:

BARNARD, Eric, Edward
Brookes & Martin
High Holborn House
52/54 High Holborn
London WC1V 6SE
ROYAUME-UNI**RECEIVED**

29 DEC 2000

BROOKES & MARTIN

Date of mailing (day/month/year) 21 December 2000 (21.12.00)		IMPORTANT NOTICE	
Applicant's or agent's file reference EEB/GCF			
International application No. PCT/GB00/02266	International filing date (day/month/year) 12 June 2000 (12.06.00)	Priority date (day/month/year) 11 June 1999 (11.06.99)	
Applicant NSK-RHP EUROPEAN TECHNOLOGY CO. LIMITED et al			

1. Notice is hereby given that the International Bureau has communicated, as provided in Article 20, the international application to the following designated Offices on the date indicated above as the date of mailing of this Notice:
AU, KP, KR, US

In accordance with Rule 47.1(c), third sentence, those Offices will accept the present Notice as conclusive evidence that the communication of the international application has duly taken place on the date of mailing indicated above and no copy of the international application is required to be furnished by the applicant to the designated Office(s).

2. The following designated Offices have waived the requirement for such a communication at this time:
AE, AL, AM, AP, AT, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, EA, EE, EP, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, OA, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZW
The communication will be made to those Offices only upon their request. Furthermore, those Offices do not require the applicant to furnish a copy of the international application (Rule 49.1(a-bis)).
3. Enclosed with this Notice is a copy of the international application as published by the International Bureau on 21 December 2000 (21.12.00) under No. WO 00/76722

REMINDER REGARDING CHAPTER II (Article 31(2)(a) and Rule 54.2)

If the applicant wishes to postpone entry into the national phase until 30 months (or later in some Offices) from the priority date, a demand for international preliminary examination must be filed with the competent International Preliminary Examining Authority before the expiration of 19 months from the priority date.

It is the applicant's sole responsibility to monitor the 19-month time limit.

Note that only an applicant who is a national or resident of a PCT Contracting State which is bound by Chapter II has the right to file a demand for international preliminary examination.

REMINDER REGARDING ENTRY INTO THE NATIONAL PHASE (Article 22 or 39(1))

If the applicant wishes to proceed with the international application in the national phase, he must, within 20 months or 30 months, or later in some Offices, perform the acts referred to therein before each designated or elected Office.

For further important information on the time limits and acts to be performed for entering the national phase, see the Annex to Form PCT/IB/301 (Notification of Receipt of Record Copy) and Volume II of the PCT Applicant's Guide.

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland	Authorized officer J. Zahra
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09/762652

IC02 Rec'd PGT/PTO 09 FEB 2001

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27 December 2000

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Dear Sirs,

Re: PCT/GB00/02266
Improvements in rolling element bearings

I refer to form PCT/ISA/220 dated 3 November 2000. I file herewith in triplicate an amended set of claims under Article 19.

Claims 1 to 10 have been replaced by amended claims 1 to 10. New claims 1 to 3 correspond to previous claims 1 to 3; new claims 4 and 5 correspond to previous claims 8 and 9; new claims 6 to 9 correspond to previous claims 4 to 7.

Claim 1 has been amended to be directed to the use of hard particle abrasion to treat a rolling element bearing component. The hard particle abrasion has been qualified as "non-corrosive" and this is supported by the specification which describes a process using water and a corrosion inhibitor. The hard particle abrasion of the present invention is therefore distinguished over the corrosive process performed under acidic conditions (around pH 1.5) described in EP 0 657 658A.

The use of non-corrosive hard particle abrasion to treat rolling element bearing components is not known. Advantageously, a bearing component treated in accordance with the invention exhibits a

International Bureau of WIPO

- 2 -

27 December 2000

significant and unexpected increase in rolling contact fatigue life (see new claim 8 and page 4, paragraph 4 of the description)

Yours faithfully,

E.E. Barnard
BROOKES & MARTIN

Enc.

Claims

1. Use of non-corrosive hard particle abrasion to treat a rolling element bearing component, the hard particle abrasion including the steps of:

immersing the bearing component in a receptacle containing hard particles; and

agitating the bearing component and/or hard particles to produce relative movement therebetween and to improve the surface topography of the component.
2. Use according to claim 1, wherein the hard particle abrasion is performed for between 10 minutes and 1 hour.
3. Use according to claim 1 or 2, wherein the relative movement is produced by rotating the component in one direction while the receptacle is rotated in the opposite direction.
4. Use according to any one of claims 1 to 3, wherein the hard particles comprise alumina.
5. A rolling element bearing component treated in accordance with any one of the preceding claims.

6. A rolling element bearing component according to claim 5 wherein the surface finish of the component is improved from around 0.13 μm to around 0.07 μm .
7. A rolling element bearing component according to claim 5 or claim 6, wherein the compressive stress in the surface of the component is increased by between 200 MPa and 500 MPa.
8. A rolling element bearing component according to any one of claims 5 to 7, wherein the rolling contact fatigue life of the component is significantly enhanced.
9. A rolling element bearing component according to any of claims 5 to 8, wherein a surface finish on the component is produced which requires no further machining.
10. A rolling element bearing comprising one or more components according to any one of claims 5 to 9.



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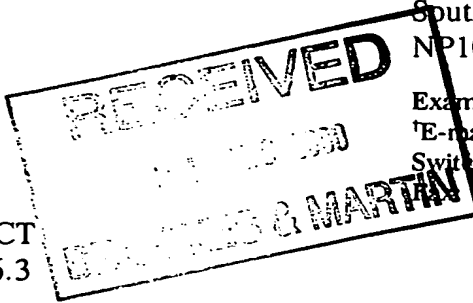
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Switchboard: 01633 814000
01633 814444

Your Reference: EEB/GCF/CT
Application No: GB 0014326.3



13 December 2000

Dear Sirs

Patents Act 1977: Search Report under Section 17(5)

I enclose two copies of my search report and two copies of the citations. Please note that these citations are examples selected from a large number of specifications found which are considered citeable against at least claim 1 regarding a lack of novelty or inventive step. You are warned that further searching may be required at the substantive examination stage once amendment has been made to overcome these citations.

Publication

I estimate that, provided you have met all formal requirements, preparations for publication of your application will be completed soon after **16 January 2001**. You will then receive a letter informing you of completion and telling you the publication number and date of publication.

Amendment/withdrawal

If you wish to file amended claims for inclusion with the published application, or to withdraw the application to prevent publication, you must do so before the preparations for publication are completed. **No reminder will be issued.** If you write to the Office less than 3 weeks before the above completion date, please mark your letter prominently: **"URGENT - PUBLICATION IMMINENT"**.

Yours faithfully

Matthew Lawson - Examiner

[†]Use of E-mail: Please note that e-mail should be used for correspondence only.



INVESTOR IN PEOPLE

Application No: GB 0014326.3
Claims searched: 1-17

Examiner: Matthew Lawson
Date of search: 11 December 2000

Patents Act 1977 Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.R): B3D (DFF, DR, DTA, DTB)

Int Cl (Ed.7): B24B 31/00, 31/02

Other: Online: PAJ, WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
Y	GB 847650 ✓	(ROLLS-ROYCE) - page 2 lines 59-77.	10,11
X,Y	GB 249219 ✓	(LINES) - the whole specification, especially page 2 lines 102-113.	X:1,2,4-9, 12,14-17 Y:10,11
X,Y	GB 227277 ✓	(WOOD) - the whole specification, especially page 2 lines 36-38, 80-90 & 116-119 and page 3 lines 10-16.	X:1,2, 4-10,12, 14-17 Y:11
X	JP 610270331 A	(AMATSUJI) - WPI Abstract Accession No. 87-011767/02 and PAJ Abv. 011133.	1,2,4-7, 12,14-17
X	JP 580090458 A ✓	(TOYOTA) - PAJ Abv. 007189 and the figures.	1-8,12-17
X	SU 000963829 A	(BONDARENKO) - WPI Abstract Accession No. 83-733786/32 and the figures.	1,2,4-8, 12-17
X	US 5070658	(RAJNER) - the whole specification, especially column 2 lines 55-59 & column 3 lines 9-41.	1,2,4-10, 12,14-17
X	US 4280302	(OHNO) - the whole specification.	1-10,12-17

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

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REQUEST

The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty.

For receiving Office use only

International Application No.

International Filing Date

Name of receiving Office and "PCT International Application"

Applicant's or agent's file reference
(if desired) (12 characters maximum) EEB/GCF

Box No. I TITLE OF INVENTION

IMPROVEMENTS IN ROLLING ELEMENTS BEARINGS

Box No. II APPLICANT

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)

NSK-RHP EUROPEAN TECHNOLOGY CO. LTD
MERE WAY
RUDDINGTON FIELDS BUSINESS PARK
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☐ This person is also inventor.

Telephone No.

Facsimile No.

Teleprinter No.

State (that is, country) of nationality:

GREAT BRITAIN

State (that is, country) of residence:

GREAT BRITAIN

This person is applicant for the purposes of:

☐ all designated States

☒ all designated States except the United States of America

☐ the United States of America only

☐ the States indicated in the Supplemental Box

Box No. III FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S)

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)

DODD, Andrew
6 Halls Brook
East Leake
Loughborough
Leicestershire LE12 6HE

This person is:

☐ applicant only

☒ applicant and inventor

☐ inventor only (if this check-box is marked, do not fill in below.)

State (that is, country) of nationality:

GREAT BRITAIN

State (that is, country) of residence:

GREAT BRITAIN

This person is applicant for the purposes of:

☐ all designated States

☐ all designated States except the United States of America

☒ the United States of America only

☐ the States indicated in the Supplemental Box

☒ Further applicants and/or (further) inventors are indicated on a continuation sheet.

Box No. IV AGENT OR COMMON REPRESENTATIVE; OR ADDRESS FOR CORRESPONDENCE

The person identified below is hereby/has been appointed to act on behalf of the applicant(s) before the competent International Authorities as:

☒ agent

☐ common representative

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)

BARNARD, ERIC EDWARD
BROOKES & MARTIN
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Telephone No.

020 7242 9631

Facsimile No.

020 7831 0586

Teleprinter No.

☐ Address for correspondence: Mark this check-box where an agent or common representative is/has been appointed and the space above is used instead to indicate a special address to which correspondence should be sent.

Continuation of Box No. III FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S)	
<i>If none of the following sub-boxes is used, this sheet should not be included in the request.</i>	
<p>Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)</p> <p>DICKS, Mark Philip 20 Hine Avenue Newark Nottinghamshire NG24 2LH</p>	<p>This person is:</p> <p><input type="checkbox"/> applicant only</p> <p><input checked="" type="checkbox"/> applicant and inventor</p> <p><input type="checkbox"/> inventor only (If this check-box is marked, do not fill in below.)</p>
State (that is, country) of nationality: GREAT BRITAIN	State (that is, country) of residence: GREAT BRITAIN
<p>This person is applicant for the purposes of:</p> <p><input type="checkbox"/> all designated States <input type="checkbox"/> all designated States except the United States of America <input checked="" type="checkbox"/> the United States of America only <input type="checkbox"/> the States indicated in the Supplemental Box</p>	
<p>Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)</p> <p>TAYLOR, Mark Stephen 10 Bateman Road East Leake Loughborough Leicestershire LE12 6LN</p>	<p>This person is:</p> <p><input type="checkbox"/> applicant only</p> <p><input checked="" type="checkbox"/> applicant and inventor</p> <p><input type="checkbox"/> inventor only (If this check-box is marked, do not fill in below.)</p>
State (that is, country) of nationality: GREAT BRITAIN	State (that is, country) of residence: GREAT BRITAIN
<p>This person is applicant for the purposes of:</p> <p><input type="checkbox"/> all designated States <input type="checkbox"/> all designated States except the United States of America <input checked="" type="checkbox"/> the United States of America only <input type="checkbox"/> the States indicated in the Supplemental Box</p>	
<p>Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)</p>	<p>This person is:</p> <p><input type="checkbox"/> applicant only</p> <p><input type="checkbox"/> applicant and inventor</p> <p><input type="checkbox"/> inventor only (If this check-box is marked, do not fill in below.)</p>
State (that is, country) of nationality:	State (that is, country) of residence:
<p>This person is applicant for the purposes of:</p> <p><input type="checkbox"/> all designated States <input type="checkbox"/> all designated States except the United States of America <input type="checkbox"/> the United States of America only <input type="checkbox"/> the States indicated in the Supplemental Box</p>	
<p>Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)</p>	<p>This person is:</p> <p><input type="checkbox"/> applicant only</p> <p><input type="checkbox"/> applicant and inventor</p> <p><input type="checkbox"/> inventor only (If this check-box is marked, do not fill in below.)</p>
State (that is, country) of nationality:	State (that is, country) of residence:
<p>This person is applicant for the purposes of:</p> <p><input type="checkbox"/> all designated States <input type="checkbox"/> all designated States except the United States of America <input type="checkbox"/> the United States of America only <input type="checkbox"/> the States indicated in the Supplemental Box</p>	
<p><input type="checkbox"/> Further applicants and/or (further) inventors are indicated on another continuation sheet.</p>	

Box No. V DESIGNATION OF STATES

The following designations are hereby made under Rule 4.9(a) (mark the applicable check-boxes; at least one must be marked).

Regional Patent

- ☒ **AP** ARIPO Patent: GH Ghana, GM Gambia, KE Kenya, LS Lesotho, MW Malawi, SD Sudan, SL Sierra Leone, SZ Swaziland, TZ United Republic of Tanzania, UG Uganda, ZW Zimbabwe, and any other State which is a Contracting State of the Harare Protocol and of the PCT
- ☒ **EA** Eurasian Patent: AM Armenia, AZ Azerbaijan, BY Belarus, KG Kyrgyzstan, KZ Kazakhstan, MD Republic of Moldova, RU Russian Federation, TJ Tajikistan, TM Turkmenistan, and any other State which is a Contracting State of the Eurasian Patent Convention and of the PCT
- ☒ **EP** European Patent: AT Austria, BE Belgium, CH and LI Switzerland and Liechtenstein, CY Cyprus, DE Germany, DK Denmark, ES Spain, FI Finland, FR France, GB United Kingdom, GR Greece, IE Ireland, IT Italy, LU Luxembourg, MC Monaco, NL Netherlands, PT Portugal, SE Sweden, and any other State which is a Contracting State of the European Patent Convention and of the PCT
- ☒ **OA** OAPI Patent: BF Burkina Faso, BJ Benin, CF Central African Republic, CG Congo, CI Côte d'Ivoire, CM Cameroon, GA Gabon, GN Guinea, GW Guinea-Bissau, ML Mali, MR Mauritania, NE Niger, SN Senegal, TD Chad, TG Togo, and any other State which is a member State of OAPI and a Contracting State of the PCT (if other kind of protection or treatment desired, specify on dotted line)

National Patent (if other kind of protection or treatment desired, specify on dotted line):

- | | |
|-------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|
| <input checked="" type="checkbox"/> AE United Arab Emirates | <input checked="" type="checkbox"/> LR Liberia |
| <input checked="" type="checkbox"/> AL Albania | <input checked="" type="checkbox"/> LS Lesotho |
| <input checked="" type="checkbox"/> AM Armenia | <input checked="" type="checkbox"/> LT Lithuania |
| <input checked="" type="checkbox"/> AT Austria | <input checked="" type="checkbox"/> LU Luxembourg |
| <input checked="" type="checkbox"/> AU Australia | <input checked="" type="checkbox"/> LV Latvia |
| <input checked="" type="checkbox"/> AZ Azerbaijan | <input checked="" type="checkbox"/> MA Morocco |
| <input checked="" type="checkbox"/> BA Bosnia and Herzegovina | <input checked="" type="checkbox"/> MD Republic of Moldova |
| <input checked="" type="checkbox"/> BB Barbados | <input checked="" type="checkbox"/> MG Madagascar |
| <input checked="" type="checkbox"/> BG Bulgaria | <input checked="" type="checkbox"/> MK The former Yugoslav Republic of Macedonia |
| <input checked="" type="checkbox"/> BR Brazil | <input checked="" type="checkbox"/> MN Mongolia |
| <input checked="" type="checkbox"/> BY Belarus | <input checked="" type="checkbox"/> MW Malawi |
| <input checked="" type="checkbox"/> CA Canada | <input checked="" type="checkbox"/> MX Mexico |
| <input checked="" type="checkbox"/> CH and LI Switzerland and Liechtenstein | <input checked="" type="checkbox"/> NO Norway |
| <input checked="" type="checkbox"/> CN China | <input checked="" type="checkbox"/> NZ New Zealand |
| <input checked="" type="checkbox"/> CR Costa Rica | <input checked="" type="checkbox"/> PL Poland |
| <input checked="" type="checkbox"/> CU Cuba | <input checked="" type="checkbox"/> PT Portugal |
| <input checked="" type="checkbox"/> CZ Czech Republic | <input checked="" type="checkbox"/> RO Romania |
| <input checked="" type="checkbox"/> DE Germany | <input checked="" type="checkbox"/> RU Russian Federation |
| <input checked="" type="checkbox"/> DK Denmark | <input checked="" type="checkbox"/> SD Sudan |
| <input checked="" type="checkbox"/> DM Dominica | <input checked="" type="checkbox"/> SE Sweden |
| <input checked="" type="checkbox"/> EE Estonia | <input checked="" type="checkbox"/> SG Singapore |
| <input checked="" type="checkbox"/> ES Spain | <input checked="" type="checkbox"/> SI Slovenia |
| <input checked="" type="checkbox"/> FI Finland | <input checked="" type="checkbox"/> SK Slovakia |
| <input checked="" type="checkbox"/> GB United Kingdom | <input checked="" type="checkbox"/> SL Sierra Leone |
| <input checked="" type="checkbox"/> GD Grenada | <input checked="" type="checkbox"/> TJ Tajikistan |
| <input checked="" type="checkbox"/> GE Georgia | <input checked="" type="checkbox"/> TM Turkmenistan |
| <input checked="" type="checkbox"/> GH Ghana | <input checked="" type="checkbox"/> TR Turkey |
| <input checked="" type="checkbox"/> GM Gambia | <input checked="" type="checkbox"/> TT Trinidad and Tobago |
| <input checked="" type="checkbox"/> HR Croatia | <input checked="" type="checkbox"/> TZ United Republic of Tanzania |
| <input checked="" type="checkbox"/> HU Hungary | <input checked="" type="checkbox"/> UA Ukraine |
| <input checked="" type="checkbox"/> ID Indonesia | <input checked="" type="checkbox"/> UG Uganda |
| <input checked="" type="checkbox"/> IL Israel | <input checked="" type="checkbox"/> US United States of America |
| <input checked="" type="checkbox"/> IN India | <input checked="" type="checkbox"/> UZ Uzbekistan |
| <input checked="" type="checkbox"/> IS Iceland | <input checked="" type="checkbox"/> VN Viet Nam |
| <input checked="" type="checkbox"/> JP Japan | <input checked="" type="checkbox"/> YU Yugoslavia |
| <input checked="" type="checkbox"/> KE Kenya | <input checked="" type="checkbox"/> ZA South Africa |
| <input checked="" type="checkbox"/> KG Kyrgyzstan | <input checked="" type="checkbox"/> ZW Zimbabwe |
| <input checked="" type="checkbox"/> KP Democratic People's Republic of Korea | |
| <input checked="" type="checkbox"/> KR Republic of Korea | |
| <input checked="" type="checkbox"/> KZ Kazakhstan | |
| <input checked="" type="checkbox"/> LC Saint Lucia | |
| <input checked="" type="checkbox"/> LK Sri Lanka | |

Check-boxes reserved for designating States which have become party to the PCT after issuance of this sheet:

☐
☐

Precautionary Designation Statement: In addition to the designations made above, the applicant also makes under Rule 4.9(b) all other designations which would be permitted under the PCT except any designation(s) indicated in the Supplemental Box as being excluded from the scope of this statement. The applicant declares that those additional designations are subject to confirmation and that any designation which is not confirmed before the expiration of 15 months from the priority date is to be regarded as withdrawn by the applicant at the expiration of that time limit. (Confirmation (including fees) must reach the receiving Office within the 15-month time limit.)

Box No. VI PRIORITY CLAIM		<input type="checkbox"/> Further priority claims are indicated in the Supplemental Box.		
Filing date of earlier application (day/month/year)	Number of earlier application	Where earlier application is:		
		national application: country	regional application: regional Office	international application: receiving Office
item (1) 11/8/99	9913658.2	GB		
item (2)				
item (3)				

☒ The receiving Office is requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) (only if the earlier application was filed with the Office which for the purposes of the present international application is the receiving Office) identified above as item(s):

* Where the earlier application is an ARIPO application, it is mandatory to indicate in the Supplemental Box at least one country party to the Paris Convention for the Protection of Industrial Property for which that earlier application was filed (Rule 4.10(b)(ii)). See Supplemental Box.

Box No. VII INTERNATIONAL SEARCHING AUTHORITY

Choice of International Searching Authority (ISA) (if two or more International Searching Authorities are competent to carry out the international search, indicate the Authority chosen; the two-letter code may be used):	Request to use results of earlier search; reference to that search (if an earlier search has been carried out by or requested from the International Searching Authority):
ISA /	Date (day/month/year) Number Country (or regional Office)

Box No. VIII CHECK LIST; LANGUAGE OF FILING

This international application contains the following number of sheets:	This international application is accompanied by the item(s) marked below:
request : 4	1. <input type="checkbox"/> fee calculation sheet
description (excluding sequence listing part) : 5	2. <input type="checkbox"/> separate signed power of attorney
claims : 2	3. <input type="checkbox"/> copy of general power of attorney, reference number, if any:
abstract : 1	4. <input type="checkbox"/> statement explaining lack of signature
drawings : 0	5. <input type="checkbox"/> priority document(s) identified in Box No. VI as item(s):
sequence listing part of description :	6. <input type="checkbox"/> translation of international application into (language):
Total number of sheets : 12	7. <input type="checkbox"/> separate indications concerning deposited microorganism or other biological material
	8. <input type="checkbox"/> nucleotide and/or amino acid sequence listing in computer readable form
	9. <input type="checkbox"/> other (specify):

Figure of the drawings which should accompany the abstract:	Language of filing of the international application:
-------------------------------------------------------------	------------------------------------------------------

Box No. IX SIGNATURE OF APPLICANT OR AGENT

Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the request).

ERIC EDWARD BARNARD

For receiving Office use only		2. Drawings: <input type="checkbox"/> received: <input type="checkbox"/> not received:
1. Date of actual receipt of the purported international application:		
3. Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application:		
4. Date of timely receipt of the required corrections under PCT Article 11(2):		
5. International Searching Authority (if two or more are competent): ISA /	6. <input type="checkbox"/> Transmittal of search copy delayed until search fee is paid.	

For International Bureau use only	
Date of receipt of the record copy by the International Bureau:	

card 3/12/00

EE

PATENT COOPERATION TREATY

From the INTERNATIONAL SEARCHING AUTHORITY

PCT

NOTIFICATION OF TRANSMITTAL OF
THE INTERNATIONAL SEARCH REPORT
OR THE DECLARATION

(PCT Rule 44.1)

To:

BROOKES & MARTIN
Attn. BARNARD, ERIC E.
High Holborn House
52/54 High Holborn
London WC1V 6SE
UNITED KINGDOM

Date of mailing
(day/month/year)

03.11.00

Applicant's or agent's file reference

EEB/GCF

FOR FURTHER ACTION

See paragraphs 1 and 4 below

International application No.

PCT/GB 00/ 02266

International filing date
(day/month/year)

12/06/2000

Applicant

NSK-RHP EUROPEAN TECHNOLOGY CO. LTD

1. ☒ The applicant is hereby notified that the International Search Report has been established and is transmitted herewith.

Filing of amendments and statement under Article 19:

The applicant is entitled, if he so wishes, to amend the claims of the International Application (see Rule 46):

When? The time limit for filing such amendments is normally 2 months from the date of transmittal of the International Search Report; however, for more details, see the notes on the accompanying sheet.

Where? Directly to the International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland
Facsimile No.: (41-22) 740.14.35

For more detailed instructions, see the notes on the accompanying sheet.

2. ☐ The applicant is hereby notified that no International Search Report will be established and that the declaration under Article 17(2)(a) to that effect is transmitted herewith.

3. ☐ With regard to the protest against payment of (an) additional fee(s) under Rule 40.2, the applicant is notified that:

☐ the protest together with the decision thereon has been transmitted to the International Bureau together with the applicant's request to forward the texts of both the protest and the decision thereon to the designated Offices.

☐ no decision has been made yet on the protest; the applicant will be notified as soon as a decision is made.

4. **Further action(s):** The applicant is reminded of the following:

Shortly after 18 months from the priority date, the international application will be published by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau as provided in Rules 90bis.1 and 90bis.3, respectively, before the completion of the technical preparations for international publication.

Within 19 months from the priority date, a demand for international preliminary examination must be filed if the applicant wishes to postpone the entry into the national phase until 30 months from the priority date (in some Offices even later).

Within 20 months from the priority date, the applicant must perform the prescribed acts for entry into the national phase before all designated Offices which have not been elected in the demand or in a later election within 19 months from the priority date or could not be elected because they are not bound by Chapter II.

Name and mailing address of the International Searching Authority



European Patent Office, P.B. 5818 Patentlaan 2
NL-2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Irene Sardjoe

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference EEB/GCF	FOR FURTHER ACTION <small>see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.</small>	
International application No. PCT/GB 00/02266	International filing date (day/month/year) 12/06/2000	(Earliest) Priority Date (day/month/year) 11/06/1999
Applicant NSK-RHP EUROPEAN TECHNOLOGY CO. LTD		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 5 sheets.

☒ It is also accompanied by a copy of each prior art document cited in this report.

1. Basis of the report

a. With regard to the language, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

b. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international search was carried out on the basis of the sequence listing :

☐ contained in the international application in written form.

☐ filed together with the international application in computer readable form.

☐ furnished subsequently to this Authority in written form.

☐ furnished subsequently to this Authority in computer readable form.

☐ the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

☐ the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. ☒ Certain claims were found unsearchable (See Box I).

3. ☐ Unity of Invention is lacking (see Box II).

4. With regard to the title,

☐ the text is approved as submitted by the applicant.

☒ the text has been established by this Authority to read as follows:

METHOD TO IMPROVE THE SURFACE TOPOGRAPHY OF ROLLER BEARING COMPONENTS

5. With regard to the abstract,

☒ the text is approved as submitted by the applicant.

☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the drawings to be published with the abstract is Figure No.

☐ as suggested by the applicant.

☐ because the applicant failed to suggest a figure.

☐ because this figure better characterizes the invention.

☒ None of the figures.

NOTES TO FORM PCT/ISA/220

These Notes are intended to give the basic instructions concerning the filing of amendments under article 19. The Notes are based on the requirements of the Patent Cooperation Treaty, the Regulations and the Administrative Instructions under that Treaty. In case of discrepancy between these Notes and those requirements, the latter are applicable. For more detailed information, see also the PCT Applicant's Guide, a publication of WIPO.

In these Notes, "Article", "Rule", and "Section" refer to the provisions of the PCT, the PCT Regulations and the PCT Administrative Instructions, respectively.

INSTRUCTIONS CONCERNING AMENDMENTS UNDER ARTICLE 19

The applicant has, after having received the international search report, one opportunity to amend the claims of the international application. It should however be emphasized that, since all parts of the international application (claims, description and drawings) may be amended during the international preliminary examination procedure, there is usually no need to file amendments of the claims under Article 19 except where, e.g. the applicant wants the latter to be published for the purposes of provisional protection or has another reason for amending the claims before international publication. Furthermore, it should be emphasized that provisional protection is available in some States only.

What parts of the international application may be amended?

Under Article 19, only the claims may be amended.

During the international phase, the claims may also be amended (or further amended) under Article 34 before the International Preliminary Examining Authority. The description and drawings may only be amended under Article 34 before the International Examining Authority.

Upon entry into the national phase, all parts of the international application may be amended under Article 28 or, where applicable, Article 41.

When?

Within 2 months from the date of transmittal of the international search report or 16 months from the priority date, whichever time limit expires later. It should be noted, however, that the amendments will be considered as having been received on time if they are received by the International Bureau after the expiration of the applicable time limit but before the completion of the technical preparations for international publication (Rule 46.1).

Where not to file the amendments?

The amendments may only be filed with the International Bureau and not with the receiving Office or the International Searching Authority (Rule 46.2).

Where a demand for international preliminary examination has been/is filed, see below.

How?

Either by cancelling one or more entire claims, by adding one or more new claims or by amending the text of one or more of the claims as filed.

A replacement sheet must be submitted for each sheet of the claims which, on account of an amendment or amendments, differs from the sheet originally filed.

All the claims appearing on a replacement sheet must be numbered in Arabic numerals. Where a claim is cancelled, no renumbering of the other claims is required. In all cases where claims are renumbered, they must be renumbered consecutively (Administrative Instructions, Section 205(b)).

The amendments must be made in the language in which the international application is to be published.

What documents must/may accompany the amendments?

Letter (Section 205(b)):

The amendments must be submitted with a letter.

The letter will not be published with the international application and the amended claims. It should not be confused with the "Statement under Article 19(1)" (see below, under "Statement under Article 19(1)").

The letter must be in English or French, at the choice of the applicant. However, if the language of the international application is English, the letter must be in English; if the language of the international application is French, the letter must be in French.

NOTES TO FORM PCT/ISA/220 (continued)

The letter must indicate the differences between the claims as filed and the claims as amended. It must, in particular, indicate, in connection with each claim appearing in the international application (it being understood that identical indications concerning several claims may be grouped), whether

- (i) the claim is unchanged;
- (ii) the claim is cancelled;
- (iii) the claim is new;
- (iv) the claim replaces one or more claims as filed;
- (v) the claim is the result of the division of a claim as filed.

The following examples illustrate the manner in which amendments must be explained in the accompanying letter:

1. [Where originally there were 48 claims and after amendment of some claims there are 51]:
"Claims 1 to 29, 31, 32, 34, 35, 37 to 48 replaced by amended claims bearing the same numbers; claims 30, 33 and 36 unchanged; new claims 49 to 51 added."
2. [Where originally there were 15 claims and after amendment of all claims there are 11]:
"Claims 1 to 15 replaced by amended claims 1 to 11."
3. [Where originally there were 14 claims and the amendments consist in cancelling some claims and in adding new claims]:
"Claims 1 to 6 and 14 unchanged; claims 7 to 13 cancelled; new claims 15, 16 and 17 added." or
"Claims 7 to 13 cancelled; new claims 15, 16 and 17 added; all other claims unchanged."
4. [Where various kinds of amendments are made]:
"Claims 1-10 unchanged; claims 11 to 13, 18 and 19 cancelled; claims 14, 15 and 16 replaced by amended claim 14; claim 17 subdivided into amended claims 15, 16 and 17; new claims 20 and 21 added."

"Statement under article 19(1)" (Rule 46.4)

The amendments may be accompanied by a statement explaining the amendments and indicating any impact that such amendments might have on the description and the drawings (which cannot be amended under Article 19(1)).

The statement will be published with the international application and the amended claims.

It must be in the language in which the international application is to be published.

It must be brief, not exceeding 500 words if in English or if translated into English.

It should not be confused with and does not replace the letter indicating the differences between the claims as filed and as amended. It must be filed on a separate sheet and must be identified as such by a heading, preferably by using the words "Statement under Article 19(1)."

It may not contain any disparaging comments on the international search report or the relevance of citations contained in that report. Reference to citations, relevant to a given claim, contained in the international search report may be made only in connection with an amendment of that claim.

Consequence if a demand for international preliminary examination has already been filed

If, at the time of filing any amendments and any accompanying statement, under Article 19, a demand for international preliminary examination has already been submitted, the applicant must preferably, at the time of filing the amendments (and any statement) with the International Bureau, also file with the International Preliminary Examining Authority a copy of such amendments (and of any statement) and, where required, a translation of such amendments for the procedure before that Authority (see Rules 55.3(a) and 62.2, first sentence). For further information, see the Notes to the demand form (PCT/PEA/401).

Consequence with regard to translation of the international application for entry into the national phase

The applicant's attention is drawn to the fact that, upon entry into the national phase, a translation of the claims as amended under Article 19 may have to be furnished to the designated/elected Offices, instead of, or in addition to, the translation of the claims as filed.

For further details on the requirements of each designated/elected Office, see Volume II of the PCT Applicant's Guide.

INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 00/02266

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 B24B1/00 B24B31/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 B24B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 657 658 A (TIMKEN CO) 14 June 1995 (1995-06-14) page 3, line 3 - line 4 page 6, line 49 -page 7, line 19 ---	1
X	US 4 280 302 A (OHNO IETATSU) 28 July 1981 (1981-07-28) column 1, line 5 - line 10 column 2, line 29 -column 3, line 32	1-3,9,10
Y	figure 5 ---	8
Y	GB 1 211 710 A (KABUSHIKI KAISHA SHIKISHIMA TIPTON) 11 November 1970 (1970-11-11) page 6, line 22 - line 34 ---	8
	--- -/--	

☒ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

* Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- "&" document member of the same patent family

Date of the actual completion of the international search

22 September 2000

Date of mailing of the international search report

03.11.00

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Petrucchi, L

INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 00/02266

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 061 298 A (BRENT CHEMICALS INT) 29 September 1982 (1982-09-29) page 4, line 24 - line 26; claims 1,8 ----	8
A	US 5 593 339 A (SPEARS JR WILLIAM E ET AL) 14 January 1997 (1997-01-14) column 3, line 5 - line 26 column 6, line 27 - line 29 -----	8

INTERNATIONAL SEARCH REPORT

International application No.
PCT/GB 00/02266

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☒ Claims Nos.: 4-7
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
see FURTHER INFORMATION sheet PCT/ISA/210
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

Continuation of Box I.2

Claims Nos.: 4-7

Claims 4 to 7 lack clarity (Article 6 PCT) because an attempt is made to define a method by reference to a result to be achieved. This lack of clarity in the present case is such as to render a meaningful search over the whole of the claimed scope impossible. Consequently, the search has been carried out for those claims which appear to be clear namely claims 1 to 3 and 8 to 10.

The applicant's attention is drawn to the fact that claims, or parts of claims, relating to inventions in respect of which no international search report has been established need not be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant is advised that the EPO policy when acting as an International Preliminary Examining Authority is normally not to carry out a preliminary examination on matter which has not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/GB 00/02266

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
EP 0657658	A	14-06-1995	US 5503481 A	02-04-1996
			DE 69418836 D	08-07-1999
			DE 69418836 T	20-01-2000
US 4280302	A	28-07-1981	NONE	
GB 1211710	A	11-11-1970	US 3513604 A	26-05-1970
EP 0061298	A	29-09-1982	NONE	
US 5593339	A	14-01-1997	US 5384990 A	31-01-1995
			US 5863883 A	26-01-1999
			US 5575705 A	19-11-1996
			US 5681205 A	28-10-1997
			US 5669945 A	23-09-1997

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference EEB/GCF	FOR FURTHER ACTION see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
International application No. PCT/GB 00/ 02266	International filing date (day/month/year) 12/06/2000	(Earliest) Priority Date (day/month/year) 11/06/1999
Applicant NSK-RHP EUROPEAN TECHNOLOGY CO. LTD		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 5 sheets.



It is also accompanied by a copy of each prior art document cited in this report.

1. Basis of the report

- a. With regard to the language, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.



the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

- b. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international search was carried out on the basis of the sequence listing :



contained in the international application in written form.



filed together with the international application in computer readable form.



furnished subsequently to this Authority in written form.



furnished subsequently to this Authority in computer readable form.



the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.



the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. ☒ Certain claims were found unsearchable (See Box I).

3. ☐ Unity of invention is lacking (see Box II).

4. With regard to the title,



the text is approved as submitted by the applicant.



the text has been established by this Authority to read as follows:

METHOD TO IMPROVE THE SURFACE TOPOGRAPHY OF ROLLER BEARING COMPONENTS

5. With regard to the abstract,



the text is approved as submitted by the applicant.



the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the drawings to be published with the abstract is Figure No.



as suggested by the applicant.



because the applicant failed to suggest a figure.



because this figure better characterizes the invention.



None of the figures.

INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 00/02266

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 B24B1/00 B24B31/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 B24B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X ✓	EP 0 657 658 A (TIMKEN CO) 14 June 1995 (1995-06-14) page 3, line 3 - line 4 page 6, line 49 - page 7, line 19	1
X ✓	US 4 280 302 A (OHNO IETATSU) 28 July 1981 (1981-07-28) column 1, line 5 - line 10 column 2, line 29 - column 3, line 32 figure 5	1-3, 9, 10
Y ✓	GB 1 211 710 A (KABUSHIKI KAISHA SHIKISHIMA TIPTON) 11 November 1970 (1970-11-11) page 6, line 22 - line 34	8
Y		8
	--- -/--	

☒ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

22 September 2000

Date of mailing of the international search report

03.11.00

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Petrucchi, L

INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 00/02266

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A ✓	EP 0 061 298 A (BRENT CHEMICALS INT) 29 September 1982 (1982-09-29) page 4, line 24 - line 26; claims 1,8 -----	8
A ✓	US 5 593 339 A (SPEARS JR WILLIAM E ET AL) 14 January 1997 (1997-01-14) column 3, line 5 - line 26 column 6, line 27 - line 29 -----	8

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

Continuation of Box I.2

Claims Nos.: 4-7

Claims 4 to 7 lack clarity (Article 6 PCT) because an attempt is made to define a method by reference to a result to be achieved. This lack of clarity in the present case is such as to render a meaningful search over the whole of the claimed scope impossible. Consequently, the search has been carried out for those claims which appear to be clear namely claims 1 to 3 and 8 to 10.

The applicant's attention is drawn to the fact that claims, or parts of claims, relating to inventions in respect of which no international search report has been established need not be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant is advised that the EPO policy when acting as an International Preliminary Examining Authority is normally not to carry out a preliminary examination on matter which has not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/GB 00/02266

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☒ Claims Nos.: 4-7
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
see FURTHER INFORMATION sheet PCT/ISA/210
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/GB 00/02266

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(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
21 December 2000 (21.12.2000)

PCT

(10) International Publication Number
WO 00/76722 A2

- (51) International Patent Classification⁷: **B24B 31/00** (74) Agent: **BARNARD, Eric, Edward**; Brookes & Martin, High Holborn House, 52/54 High Holborn, London WC1V 6SE (GB).
- (21) International Application Number: **PCT/GB00/02266**
- (22) International Filing Date: **12 June 2000 (12.06.2000)** (81) Designated States (*national*): AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.
- (25) Filing Language: **English**
- (26) Publication Language: **English**
- (30) Priority Data: **9913658.2** ✓ **11 June 1999 (11.06.1999)** **GB**
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- (84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).
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Published:

— *Without international search report and to be republished upon receipt of that report.*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: **IMPROVEMENTS IN ROLLING ELEMENTS BEARINGS**

(57) Abstract: A method of treatment of a rolling element bearing component by hard particle abrasion to improve the surface topography of the component. The hard particle abrasion includes the steps of immersing the bearing component in a receptacle containing hard particles, preferably alumina, and agitating the component and/or hard particles to produce relative movement. Preferably the method is performed for between 10 minutes and 1 hour. The relative movement may be produced by rotating the component in one direction while the receptacle is rotated in the opposite direction. The surface finish of the component is preferably improved from around 0.13 μm to around 0.07 μm . Compressive stress in the surface of the component may also be improved, typically by between 200 MPa and 500 MPa. Rolling contact fatigue life of the component is also improved.

WO 00/76722 A2

IMPROVEMENTS IN ROLLING ELEMENTS BEARINGS**TECHNICAL FIELD**

The present invention relates to rolling element bearings and, more particularly, the invention relates to improvements in the performance of such bearings by treatment of the individual bearing components subjected to rolling contact during use i.e. the inner ring, outer ring and rolling elements.

SUMMARY OF THE INVENTION

It is an object of the invention to provide a method of treatment of such rolling element bearing components to improve the properties of the component. It is also an object of the present invention to improve the performance of bearings generally.

According to an aspect of the invention there is provided a method of treatment of a rolling element bearing component by hard particle abrasion of the component, the hard particle abrasion comprising the steps of:

immersing the bearing component in a receptacle containing hard particles; and
agitating the bearing component and/or hard particles to produce relative movement therebetween and to improve the surface topography of the component.

According to another aspect of the invention there is provided a rolling element bearing component treated in accordance with the method of the invention.

According to a further aspect of the invention there is provided a rolling element bearing comprising such a component or components.

BACKGROUND

The process of hard particle abrasion, or ceramic abrasion, is known in the art and hard particle abrasion equipment is commercially available.

DESCRIPTION

Hard particle abrasion of rolling element bearing components may simply involve immersing one or more of the bearing components in the receptacle containing the hard particles and usually a fluid carrier. The particles are typically alumina or other ceramics and can vary in size from a few microns to over a millimetre. The hardness of the particles is normally equal to or greater than that of the bearing component to be treated and the fluid is usually water. Corrosion inhibitors may be added to the fluid.

The or each bearing component and/or the hard particles in the fluid are agitated to give relative movement between the bearing components and the particles. The resulting

impact or action of the hard particles on the surface of the bearing component primarily modifies the topography of the surface, giving an improved surface finish, and preferably induces beneficial residual compressive stress in the surface. The modified surface topography has better tribological properties and the residual stress offsets the stresses experienced by the bearing component during use. Preferably, the surface finish of the component is improved to below $0.10\text{ }\mu\text{m}$, preferably to around $0.07\text{ }\mu\text{m}$. A pre-treatment surface finish of around $0.13\text{ }\mu\text{m}$ could be typical.

The process of hard particle abrasion when applied to bearing components alleviates surface defects that can be introduced into the component surface, for instance the raceway surface, by conventional grinding and honing. In addition, consistently good surface finishes can be achieved, preferably without the need for expensive finish grinding and honing.

DETAILED DESCRIPTION OF PREFERRED IMPLEMENTATIONS

In practice several components are treated at once.

In an example of performing the method of the present invention, bearing components are treated for around 30 minutes. The components are supported in a bath containing water with a corrosion inhibitor and alumina particles of size 10 microns. Relative

movement between the bearing components and alumina particles is provided by rotating the components in one direction while the bath is rotated in the opposite direction.

A range of alumina particle sizes may be used and an alternative example uses a typical particle size of 1 mm. Generally, the components are treated for between 10 minutes to 1 hour although 30 minutes is typical. Generally, the speed of rotation of the bath is between 30 rpm and 90 rpm, typically 60 rpm and the speed of rotation of the component is between 5 rpm and 15 rpm, typically 10 rpm.

An assessment before and after such abrasion of bearing inner rings made in M50 NiL material shows that the surface finish (Ra) is improved from around 0.1282 to 0.0715 μm . The roundness of the rings was not significantly affected and the material removed per surface was about 4 μm . The raceway of the ring required little or no further grinding or honing.

Polymet testing of ceramically abraded bearing components made in M50 NiL material gave an improvement in fatigue life of over 12 times that of untreated components.

Measurement of the residual compressive stress in the surface of M50 NiL bearing components shows that ceramic abrasion increases the compressive stress in the surface of the components by several hundred MPa. The increase in residual compressive stress

produced in the surface of a component treated in accordance with the method of the invention is between 200 MPa and 500 MPa, typically 400 MPa.

The improved surface topography and the residual compressive stress induced in the surface of the bearing components improve the fatigue resistance of the bearing components and consequently the bearing itself. In particular rolling contact fatigue performance is improved.

Rolling element bearings comprising components that have been treated in accordance with the invention may be used where an improvement in bearing performance is required. Particular examples are gas turbine engine main shaft bearings for use in aerospace or other applications.

Claims

1. A method of treatment of a rolling element bearing component by hard particle abrasion of the component, the hard particle abrasion including the steps of:

immersing the bearing component in a receptacle containing hard particles; and

agitating the bearing component and/or hard particles to produce relative movement therebetween and to improve the surface topography of the component.
2. A method according to claim 1, wherein the method is performed for between 10 minutes and 1 hour.
3. A method according to claim 1 or 2, wherein the relative movement is produced by rotating the component in one direction while the receptacle is rotated in the opposite direction.
4. A method according to any one of claims 1 to 3, whereby the surface finish of the component is improved from around 0.13 μm to around 0.07 μm .
5. A method according to any one of claims 1 to 4, whereby the compressive stress in the surface of the component is increased by between 200 MPa and 500 MPa.

6. A method according to any one of claims 1 to 5, whereby the rolling contact fatigue life of the component is significantly enhanced.

7. A method according to any one of claims 1 to 6, whereby a surface finish on the component is produced which requires no further machining.

8. A method according to any one of claims 1 to 7, wherein the hard particles comprise alumina.

9. A rolling element bearing component produced by the method of any one of the preceding claims.

10. A rolling element bearing comprising one or more components according to claim 9.